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Navy Specification Study
Report 1
Industry Survey

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DEPARTMENT ◆ OF DEFENCE
DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION

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Electronics and Surveillance Research Laboratory

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ABSTRACT

Technical Report

This paper presents the results of a survey of companies involved in the development and supply of complex operational computer based systems for Navy. The objective of the survey was to gain feedback from industry regarding the quality of Navy's requirements specifications. The survey is part of a more general study aimed at improving Navy's specification and evaluation practices.

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Contents

Abbreviations

ADO	Australian Defence Organisation
BITE	Built In Test Equipment
CSV	Comma Separated Variables
DI	Defence Instruction
GENSPECS	General specifications for ships of the United States Navy
MTTR	Mean Time to Repair
MWSC	Minewarfare Systems Centre
RFP	Request for Proposal
RFT	Request For Tender
STANAG	Standard NATO Agreement
TSC	Technical Subject Code

1. Introduction

This paper presents the results of a survey of companies involved in the development and supply of complex operational computer based systems for Navy. The objective of the survey was to gain feedback from industry regarding the quality of Navy's requirements specifications. The survey is part of a more general study aimed at improving Navy's specification and evaluation practices.

The full series is as follows:

Report 1: Industry survey	A survey of industry perceptions of Navy specifications.
Report 2: Current policy and practice	Examines the current policy and practice regarding the development of specifications in Navy. (Not Public Release.)
Report 3: Requirements and specifications	A comprehensive review of the needs for Navy specifications, providing recommendations for their improvement.
Report 4: Executive summary and final recommendations	Consolidated recommendations arising from Reports 1, 2 and 3. (Not Public Release.)

The specifications under review are those provided as part of a Request for Proposal (RFP) or Request for Tender (RFT). In general, these specifications contain performance and functional requirements as well as build standard requirements. They are based on, and traceable to, higher level operational requirements prepared by end user representatives. The higher level requirements documents are not normally provided to potential tenderers.

Surveys of this type provide an unavoidably jaundiced view of the subject. Participants were encouraged to criticise specification practices and did so. As a result the majority of the comments were negative and this report reflects those views. Where possible, however, we have also documented positive comments indicating practices preferred by the participants.

While this paper discusses problems with Navy specifications, several participants expressed the view that Navy specifications are often superior to other Defence specifications, particularly in providing a clear and reasonably high level representation of the requirements. In addition, few of the comments applied to *all* specifications produced by Navy, and most of the comments were applicable in some measure to other Defence specifications. In this regard, this paper is generally relevant to all Defence specifications for operational systems.

A recent survey into the costs of tendering for Defence projects resulted in several comments relevant to this survey. These are discussed in Section 16.

Finally, it should be noted that, although some comments are made on the participants' suggestions, the aim of this paper is to document industry perceptions. While it is important that their views are considered, tenderers are only one of several important audiences for specifications. Accordingly, this paper should not be viewed either as a recipe for specifications or a blueprint for future changes. A traceability matrix is provided in Appendix 2 showing where issues raised here are addressed in Reports 2 and 3.

2. Acknowledgments

The authors wish to acknowledge the cooperation and assistance of staff in the following organisations who participated in the survey.

Atlas Elektronik

Australian Defence Industries

Australian Submarine Corporation

AWA Defence Industries

Blohm and Voss

British Aerospace Australia

CEA

CelsiusTech Australia

Computer Sciences Corporation

GEC-Marconi Systems

Rockwell Systems Australia

Stanilite

Thomson Sintra Pacific

Transfield Shipbuilding

3. The survey

In all, 14 companies participated in the survey. These constituted the majority of Australian companies which might be expected to tender for combat systems and other major operational computer based systems in Australia. Some of the systems addressed are shown below.

ANZAC Frigate combat system and ship control system

Hydrographic Ship science suite

Collins Submarine combat system and ship control system

Minehunter Coastal combat system

Minewarfare Systems Centre

Patrol Vessel combat system

There was also some discussion of specifications from Defence clients other than Navy, including Army, Air Force and Defence Materiel. In total, more than 20 separate projects were discussed in the interviews. Discussions typically covered most of the projects that contractors had tendered for, and were not restricted to projects in which they had been awarded the contract.

The survey was conducted by structured interviews, with the industry participants being provided with a list of subjects to be addressed prior to the interviews. The questionnaire used is shown in Appendix 1. The subjects addressed included the following:

Content and completeness

Level of requirements

Structure, format and language

Non-functional requirements

Other specific concerns including testability, prioritisation and security issues

Electronic form of specifications

Pre-release of specifications to tenderers

Industry specification practices

There was a high level of cooperation from participants resulting in extremely frank comments at times. This was supported by guarantees of confidentiality on our part, so that specific comments are not attributed to individuals or companies.

4. Content and completeness

The *content* of a specification here refers to the appropriateness of requirements rather than the level of detail provided in the specification or the manner in which the requirements are presented (which are addressed elsewhere in this

paper). *Completeness* refers to whether the full requirement, as envisioned by the potential tenderer, is encompassed.

4.1 Assumed knowledge

Tenderers have difficulties in understanding some requirements which appear to be inconsistent or poorly matched to the bulk of the specification. This problem is often attributed to the drafter of the specification using assumptions which are unknown to the tenderer.

4.2 "Cut and paste" approach

Requirements are sometimes copied from previous projects with limited consideration of whether they are appropriate for the system being specified. Specific concerns with this practice included the following.

a. Requirements which are suitable for one project will not necessarily be suitable for another. The roles of two ships may be different, for example, and the required performance of their systems will usually be different.

b. Requirements copied from an older project may not reflect advances in technology and system performance. This is discussed further in Section 4.4.

4.3 "Glossy brochure" approach

There were suggestions from participants that some specifications are based on promotional material ("glossy brochures") from defence suppliers, rather than genuine requirements, although it was also stated that this problem has improved in recent years. The concerns raised included the following.

a. Figures provided in promotional material are often the best performance that can be achieved under optimal environmental conditions. They are almost universally more optimistic than the typical performance which might be expected from systems, or the performance that a tenderer can guarantee in a contract. Use of such figures will ensure that no tenderer can be compliant.

b. Where several of the performance characteristics of a specific system are echoed in a specification, the specification may reflect the actual design of that system rather than Navy's higher level requirements. Competing systems will have a different set of characteristics which, while they may meet the higher level requirements, cannot match the specified requirements point by point.

c. It was suggested that in some cases the requirements were based on a combination of performance figures from different brochures.

In these cases, it is evident either that no existing equipment will meet Navy's requirements, or at best that only one set of equipment will be compliant. The likely consequences are that competition is decreased and that there is less likelihood that existing equipment will meet the requirements.

4.4 Technology constraints

Some specifications have included requirements which preclude the use of more advanced technology. Tenderers have then been reluctant to offer solutions which would have provided enhanced performance and reduced costs, but which would be formally non-compliant.

Most participants recommended that particular care should be taken when requirements relate to immature, emergent or rapidly changing technologies, and that in these cases requirements should be stated at as high a level as is prudent. This is particularly relevant for long projects where technology advances during the course of the project may make some detailed requirements (such as requirements for computer types and capacities) either obsolete or difficult to achieve.

4.5 "Umbrella" clauses

Requirements which apply to the entire system or to several components can cause problems for a tenderer where, in the tenderer's opinion at least, the requirements are inappropriate for some system components. This occurs frequently with regard to non-functional requirements including build standards. A common example is "All software shall be developed in accordance with DOD-STD-2167A, *Defense System Software Development*". The tenderer knows than many of the proposed system components which contain software (often in the form of firmware) already exist, but is uncertain about the status of that software. He is faced with the following problems:

- Does the requirement apply to tried and tested firmware in items such as monitors and printers?
- Does it apply to existing software in subsystems such as radars?
- Does it apply to existing mission specific software or only to new software?
- Should any existing software be redeveloped or redocumented to conform with the standard?

The tenderer cannot answer these questions in isolation, and requires further guidance from the customer.

4.6 Environmental constraints

Some tenderers felt that the operational environment is not defined in sufficient detail. This applies both to external environmental factors (such as sea state, wind and temperature) and to the environment in which the equipment is installed, e.g. within a ship.

4.7 Traceability of operational to performance/functional requirements

Several participants commented on the lack of clear traceability between operational requirements, where provided, and corresponding performance and functional requirements. It was suggested that some of the lower level requirements were either "created from nothing" or were based on operational requirements which had not been identified in the specification (see also Section 4.1). This has resulted in a difficulty in understanding the context of requirements and a subsequent difficulty in responding to them.

4.8 Use of standards

There was considerable concern about the referencing of military specifications and other standards. Typical problems included the following.

a. Referenced standards may be inappropriate for the application.

b. Standards listed as applicable documents are sometimes not referenced in the text of the specification, raising doubt as to their applicability.

c. Some standards (eg DOD-STD-2167A) require specific decisions to be made or actions to be performed by the customer, but the customer does not appear to be aware of these obligations.

d. Many standards are multi-level providing for different levels of compliance depending on the needs of the application. In some cases the actual level required is not stated.

e. The use of "orphan" standards which are not widely used either in defence or industry can seriously impact cost and schedule.

f. Many standards have not been updated with advances in technology or changes in the ADO organisation. The ABR and DI(N) series were specifically mentioned in this regard. It was suggested that a comprehensive review process to upgrade or retire such standards would significantly reduce this problem.

g. Some referenced standards (e.g. STANAGs) are difficult or impossible to obtain.

Most tenderers would welcome both the tailoring of standards by Navy for specific projects and the provision of guidance on the applicability and use of referenced standards.

4.9 Completeness of requirements

There were no criticisms of the completeness of specifications. While this might be seen to be a tribute to specification drafters, it is more likely due to the fact that missing requirements do not usually result in problems for the contractor.

Instead, their impact is borne by Navy both in performance and cost. Participants also felt that the channels available to resolve such problems (with the Project Office) generally worked well.

5. Level of requirements

5.1 Uneven level in specifications

All participants commented on the uneven level of individual specifications. While it was clear that some requirements had been specified at too high a level, and others too low, there was rarely complete agreement between participants with regard to specific problems. Problems cited included:

a. Different drafting styles in the same specification, particularly in different system areas (e.g. the Combat System compared with the Communications System).

b. Evident variability in the experience of drafters.

c. Copying from earlier specifications which use quite different formats and drafting styles.

d. Mixing of genuine requirements with partial solutions, which may lead to serious problems in designing a cost effective solution.

e. Areas of overspecified requirements, including identification of computer types and computer languages, specification of solutions rather than requirements, detailed requirements which assume a particular solution, and specification of inappropriate processes and protocols.

f. Areas of underspecified requirements, including the operating environment, maintenance, simulation for training, administrative computing and fault tolerance.

There was acceptance from most participants that some variability in the level of specification is appropriate and unavoidable. One example occurs where the interfaces of a system to existing equipment must be strictly defined, but other aspects of the system can be specified solely in terms of performance and functions. The level is likely to vary with both how detailed the users' requirements *need* to be defined and how detailed they *can* be defined. This is discussed further below.

It was also accepted that in some cases functional requirements will be incomplete; that only a subset of the required functions will be specified. In these cases it was recommended that the higher level requirements are clearly identified, so that the complete set of functional requirements can be derived by the tenderer.

5.2 Vague requirements

The use of requirements which express a genuine need, but in a form which is too general to be completely understood, concerned participants. Requirements such as "shall maintain the existing capability", "shall be compatible with current Navy protocols" and "shall be a fully integrated system" were seen as being very difficult to address. It was suggested that either the requirement should be clarified, or that guidance should be provided on how tenderers should respond to the requirement.

5.3 What is the correct level?

The variation of responses to our questions with regard to level was interesting. The discrepancies applied to individual specifications, where there were different views on the quality of a given specification, and also specific technology areas, such as communications.

Most participants agreed that there is no "correct" level of specification which will be appropriate for all projects or suit all tenderers. Tenderers with extensive experience in a particular domain prefer high level specifications, whereas the same tenderers will prefer detailed requirements in areas where their experience is less. Similarly, specification drafters depend heavily on their own and Navy's experience both in the application domain and technologies involved. It appears that most problems in level of detail, both too high and too low, occur when the drafter has insufficient or inappropriate experience. The most serious problems occur when both Navy and the tenderer have a low level of experience.

Participants were particularly scathing about inappropriate or incorrect (in their opinion) overspecification, which they believed had precluded cost effective solutions.

Cases were also cited where the level of specification was "exactly wrong"; where for example specific tools were required but no indication was provided on why the tools were selected or how they would be used to meet the higher level requirements. In these cases tenderers would have found either a higher or lower level acceptable.

One interesting outcome of the survey was an almost universal opinion among the participants that all specifications contain areas where the requirement is inadequately specified, i.e. where more detail is needed to guide the tenderer. This contradicts a common belief that the problems are solely in the other direction, that overspecification is by far the major problem. Individual concerns with high level specifications included the following.

a. There is a significant risk that the customer will not agree with the derived requirements, and will reject the solution.

b. The tenderer needs to make too many guesses.

c. If Navy cannot specify its requirements, neither can the tenderer.

d. Acceptance of systems with complex user interfaces becomes very difficult and a serious area of risk to the contractor.

e. High level performance specifications are incompatible with fixed price contracts.

6. Structure and format

Structure here refers to the (usually) methodical approach to organisation of the requirements in the specification. *Format* refers to the layout of the specification document, which can also dictate or constrain the structure.

Many of the suggestions relating to structure and format stemmed from difficulties in importing specifications into requirements databases. Most tenderers parse specifications into database or dedicated requirements traceability tools. The objective of the parsing process is to identify and classify each discrete requirement in the RFT/RFP package (including implicit requirements in some cases) to assist in ensuring that the tender or proposal addresses all requirements. Various characteristics of the specification can assist in or detract from the parsing process.

6.1 Use of defined formats

There was general concern about the variability in structure and format of the specifications experienced. Ship specifications have usually been based on the GENSPECS (General Specifications for Ships of the United States Navy) standard, using Technical Subject Codes (TSCs) to partition the requirements. System specifications are often loosely based on MIL-STD-490A (even when the ship specification uses GENSPECS). Most participants recommended the use of the 490A System Specification format - almost all participants use strict 490A formats for their own subcontract specifications.

The reasons given for preferring MIL-STD-490A were that this standard provides a predictable framework for the more common requirement criteria, is more likely to encourage completeness of specification, and is reasonably well understood in the industry.

Several participants criticised the use of GENSPECS and 490A formats for integrated systems, because of the difficulties in representing integrated requirements in a partitioned form (using TSCs) or a strictly hierarchical form (for 490A). It was generally agreed that the structure of the actual *performance* requirements should be appropriate to the system being specified, rather than follow the directives of 490A, for example. It was felt that the use of TSCs in particular encouraged drafters to design systems to the equipment level rather than to concentrate on the establishment of performance and functional requirements.

6.2 Individual format issues

Problems in parsing specifications into discrete requirements prompted many suggestions regarding the layout of specifications. These comments included the following.

a. Each clause should contain only one requirement. While this is often quoted as a good objective, there is often disagreement between different parties as to what constitutes a single requirement. This will also vary when tenderers have different specific solutions or a conceptual design in mind. If a single requirement is met by a single component or equipment, there will generally be no problem if the requirement has two or more components.

b. Avoid using tables to identify requirements. Tables are difficult to parse using automated parsing tools, but are a useful way of presenting large numbers of simple requirements such as data items.

c. Avoid using lists (such as this one) in requirements, because each individual requirement may not make sense without the preceding text at the start of the list.

d. Avoid "overlap" requirements where the requirements for one section refer to the requirements in another, with specific additions or exclusions. An example of such a requirement is "all data in paragraph 4.17 shall be recorded, with the exception of operator errors and BITE data". Again, the requirement is not complete in itself. In addition, participants identified such requirements as likely candidates for inconsistencies and suspect requirements (requirements which the tenderer believes are not genuinely intended).

e. Minimise "umbrella" clauses where the scope of a requirement applies to all or several system components.

f. Collect like requirements together or provide cross-references where this is not feasible. An example of this is data recording requirements where the requirements for recording might be scattered through the specification in different functional areas. It will not always be possible to group related requirements in integrated systems because a single function will often be provided by several system components. In the data recording example, the requirements for the recording of navigational data, for instance, could be specified as part of the navigation requirements or as part of the recording requirements.

Many of these suggestions, if implemented strictly, could drastically reduce the readability of specifications, which in turn would adversely affect the validation of requirements and the ability of readers in general to assimilate the meaning of specifications. A compromise is evidently needed here, where the requirements for parsing are traded off against the needs of readability.

For example, the "one requirement per clause" rule is now usually followed in Navy, but not to the point of absurdity. There is often a difference of opinion on what constitutes a single requirement. Examples of Navy specifications parsed by tenderers and sighted by the authors have shown both the merging and splitting of requirements, with different approaches taken by different tenderers. Similarly, participants were divided in their opinions of how well requirements were partitioned in the same specifications.

6.3 Numbering of requirements

Several participants believed that the assignment by Navy of a unique number to each requirement (in effect each "shall") would be very useful. This would reduce the probability of a contractor "losing" a requirement during parsing and aid in cross referencing requirements between different specifications. The approach used in the MWSC project, where sub-requirements in each clause were numbered ([1], [2], etc.), was generally seen as adequate; in this case a requirement could be referred to as 3.7.1.4[3], for example. In other specifications requirements have been numbered using a sequential numbering scheme (in addition to and separate from clause numbers).

It is important to note here that the ordering of numbers is not seen as important, nor is the fact that some numbers in the sequence may not be used (after requirements are deleted, for example). The important issue is that each requirement may be uniquely referred to, and that the identifying number does not change after the first release of the specification.

The generation and maintenance of such numbers may be difficult to manage without the likelihood of duplications, omissions and errors. This problem will be examined in a subsequent report.

6.4 Precedence of specifications, standards and requirements

The precedence of different specifications, standards and requirements needs to be carefully considered and defined where there is any likelihood of overlap. It should be noted that the *precedence* of requirements is not the same as the *priority* of different requirements which is discussed in Section 8.

6.5 Dispersed requirements

Associated requirements should be addressed in a single specification where possible. Participants quoted projects where technical requirements relating to a common area appeared in the specification, the RFT Terms and Conditions, the Data Item Descriptions and/or the Statement of Work. (The collection of like requirements within a specification is addressed in Section 6.2.f.)

7. Verification of requirements

Most participants stated that all requirements should either be testable, or an indication should be provided on how they will be evaluated. In some cases the level of capability required had not been clear to those preparing the technical proposal, and it was felt that some indication of how the capability would be verified would help to clarify the requirement. Where the method of verification (which includes testing) is not obvious, it was recommended that the specification should provide guidance on what verification methods might be used in system acceptance.

It should be noted that for a *contractual* specification, all requirements need to be subject to verification, usually by testing, inspection or analysis.

8. Prioritisation of requirements

Many participants felt that a clear prioritisation of requirements would improve their ability to apply cost benefit analysis and criticality analysis techniques in Navy projects. It was suggested that prioritisation to 3 levels - mandatory, highly desirable and desirable - would be a marked improvement on current practices. Clear definition of operational requirements, including the operational concept, would help the tenderer to assess priorities.

There appears to be a suspicion that some requirements are more speculative than real, and that these will not be treated seriously in the tender evaluation process. Participants also stated that in some cases they get a different impression of the relative importance of requirements in discussions with staff from different areas in Navy. This latter problem, although a concern, is perhaps understandable - specialists tend to regard their own part of a project as the most important. Any solution to this problem should address the promotion of a firm official position with regard to priorities rather than reduce the already limited dialogue between the tenderers and specialists.

In most specifications the prioritisation is limited to mandatory ("shall") and non-mandatory ("should" or desirable) requirements. There were indications during the interviews that tenderers have difficulty in addressing non-mandatory requirements, because of uncertainty in how these requirements are treated in evaluations. This is also shown in tender responses which are highly variable in their treatment of non-mandatory requirements.

9. Use of language

The use of language is not generally regarded as a cause of serious problems.

9.1 Definition and use of terms

There were some concerns about the use of specialised operational terms which are not adequately defined or which are used inconsistently. The different meaning of such terms in the military in Australia, the US and Europe has also led to some problems.

9.2 Concurrency

Whether functions are required concurrently or not is often not clearly specified. This often results in problems when the contractor designs the functions to be mutually exclusive but the customer assumes that both (or all) functions will be available simultaneously.

9.3 Alternative functions

Where alternative functions are specified, it is not always clear whether the choice is being offered to the tenderer or the operator. An example might be "Positions shall be entered either graphically or numerically using the keyboard". This probably means that the operator needs two alternative methods of entering position, but it could also be interpreted as meaning that the designer has a choice of providing either graphical or numeric entry, without providing both. The use of "or" in a requirements clause can quite often be ambiguous.

10. Non-functional requirements

Requirements which do not relate directly to the performance or functions of a system are often referred to as non-functional requirements. Typical non-functional requirements are the "ilities" (availability, maintainability, compatibility and other quality factors), build standards and user interfaces. It should be noted that, despite their name, these requirements usually do contribute to the overall effectiveness and/or efficiency of a system.

Non-functional requirements are viewed as a serious area of risk. Most participants stated that they are typically poorly defined, difficult to respond to, and in many cases difficult to verify (they are often not easy to test or measure). There were also suggestions that this area is particularly prone to misunderstandings in the use of special terms. Specific comments concerning these requirements were as follows.

a. Non-functional requirements should be clearly derived from the operational requirement where possible.

b. All non-functional requirements need to be considered and specified. The use of a comprehensive checklist by Navy would assist in this regard.

c. In some cases there are direct conflicts between different requirements. One example is where the requirements for availability and MTTR (Mean Time to Repair) cannot be reconciled.

d. There is little consideration given to the quality factors for shore based facilities.

e. Specification of requirements for the user interfaces is seen to be a critical problem area. Trying to meet the subjective views of customers is seen as a serious risk.

f. Customers need to understand that verification of non-functional requirements in particular may involve more than, or exclude, testing. Alternative methods may include analysis, inspection and comparison with existing systems.

11. Security issues

Tenderers stressed the costs and time delays in handling classified requirements and documents, and believe that there are often cases of overclassification which makes these penalties unnecessary. Other comments included the following.

a. Portion marking (individual paragraph classification) is strongly preferred to blanket document classification.

b. Separation of classified from unclassified material using different documents is preferred to documents of mixed classification, particularly where there are relatively few classified requirements. The use of classified annexes, particularly for the extraction of performance figures ("magic numbers"), was recommended.

12. Electronic form of specifications

Navy specifications are now routinely provided to tenderers in electronic form as wordprocessor documents or databases. Tenderers strongly support this practice and consider it essential that all RFT/RFP information is provided in electronic form. Participants commented on the variability in both the format of the specifications and how the generation tools are used. (This has been aggravated by the recent change of the wordprocessor type generally used within Navy.)

Understandably, participants preferred the use of popular brand tools, and some were strongly critical of Filemaker Pro (database tool) and Wingz (spreadsheet) in this regard. Many stated that they would prefer to immediately import such material into their database of choice, rather than use a tool which they are unfamiliar with or which is inadequate for their purposes. They recommended that the specification be provided both as generated, and in a popular compatibility format suitable for importation into other tools.

Similarly, where tender responses are required in a specific format, it was suggested that a popular compatibility format should also be acceptable. (An example of a popular compatibility format for databases is comma separated variable (CSV) which is computer independent and suitable for import to and export from all modern database tools.)

It was also suggested that Navy defines and applies standards formalising how the tools are used within Navy. The use of consistent wordprocessor formatting using styles, for example, not only enhances the consistency of the specification format, but also can be very useful in parsing for requirements management by the tenderer. Seemingly simple issues such as the inclusion of hard page breaks and the arbitrary or manual formatting of paragraphs and headings can cause problems, particularly when the tenderer needs to process several versions of a specification.

It was also noted that the use of graphics in specifications can cause problems in electronic handling, particularly in increasing the size of the file, and in compatibility between different tools. It was suggested that graphics should not be explicitly included in the specification file, but instead be linked into the document from separate individual files. (This is possible in most modern wordprocessing tools including Microsoft Word and WordPerfect.)

13. Pre-release of specifications

All participants supported the pre-release of draft specifications, provided for information or for comment. Some felt that the opportunity to comment on the draft specification was useful, to modify the requirement and improve their ability to submit a compliant tender. They also welcomed the chance to discuss the requirement informally with Navy project staff, specialists and users, to give them a better understanding of the requirement, an activity which is not possible later in the procurement process. Others believed that commenting on the specification might result in changes that helped other tenderers and were more cautious in doing so. Some expressed concern that by asking basic questions relating to the requirements, they might create an impression of not being conversant with the application domain, and that this might also tend to reduce the feedback they might provide to the project.

All saw the increase in their lead time for the preparation of proposals as being one major advantage of their viewing a draft version of the specification.

14. Miscellaneous issues

14.1 Additional information - need for operational requirements

All tenderers desire more information relating to the operational requirements, which they believe would significantly improve their ability to respond to the requirements. Most have had difficulty in resolving how some individual

performance and functional requirements might have been derived and attempt to postulate the operational requirements themselves using reverse engineering, often with a low level of confidence. In most cases the information required does not need to be a formal part of the requirements, and could be provided as a preface or annex to the specification.

Several participants stated that they would welcome any additional information relating to the requirements that can be provided. One example of additional information cited was annotations or notes clarifying, justifying or commenting on the requirements.

14.2 Overall specification quality

Several participants suggested that many of the problems in specifications might be averted if Navy could establish generic quality guidelines for their specifications, and review each specification against those guidelines prior to release.

14.3 Relationship with customer

Some participants indicated that they would prefer a much closer relationship with the customer. They felt that the contractual relationship as currently conducted prevents or distorts important discussions between the supplier and the customer relating to the overall requirements.

14.4 Extraneous issues

Our discussions were primarily aimed at Navy's specifications, but numerous other issues were raised which participants thought detracted from their ability to respond adequately to RFT/RFPs. These are not discussed in this report. Several participants believed that there are more serious problems in other aspects of the tendering process than in the actual specifications. (One example which was raised by several participants was the amount and format of tender documentation deliverables required by projects.)

15. Industry specification practices

We were interested in how different tenderers' specification practices differ from Navy's, particularly because they are based on the same original requirements. In many cases, where a major system is subcontracted, as is likely when a subcontractor supplies a combat system for a ship, Navy's requirements are generally passed on virtually unchanged to the subcontractor, with additional (typically more stringent) environmental and build standard requirements.

For smaller systems and system components two quite different approaches appear to be common, depending on the products required and the prime contractor's experience with the technologies or application involved.

a. Provide a product or product development specification with detailed requirements, generally at a level lower than those used by Navy. The reason given for the prime contractor using a low level specification was that they know what they want, include as much information as they can, and see a detailed specification as the best method for achieving their objective.

b. Provide a short, high level description of requirements, and award a contract on the basis of a product or product development specification.

Almost all of the participants use a MIL-STD-490A format (or DOD-STD-2167A for software) as a basis for specification for subcontractors. The reasons given for preferring MIL-STD-490A were that this standard provides predictable hooks for the more common requirement criteria, is reasonably complete and is reasonably well understood in the industry.

Several participants stated that their own RFTs provide more detailed guidance than Navy on how the tenderer should respond to the requirements, and in some cases a specification blank is included for the tenderer to complete.

Most do not currently provide explicit numbering of requirements (discussed in Section 6.3), but intend to do so in the future.

16. Costs of tendering survey

Recently a survey was commissioned to review Defence procurement practices, particularly with regards to costs of industry tendering for Defence projects. The results of the survey, which encompassed 80 firms, were published in *Costs of Tendering Industry Survey,* Australian Government Publishing Service, Canberra, 1994. It should be noted that the survey encompassed all Defence procurement and was not selective about the types of projects covered (although 48% of respondents were from the information technology, electronics and communications sector). Participants were those doing "significant amounts of business (i.e. contracts of $1 million or more) with Defence".

Many of the responses and comments provided in the survey are relevant to specifications and reinforce the results of our survey. These included:

- Poor requirements specifications which vary during the tendering process.
- Requirements written around dated technology.
- Overly prescriptive specifications.
- The large numbers of standards to be obtained.
- An "arms length" approach requiring the tenderer to guess requirements.
- The need for clear specification of requirements.
- Preference for fewer optional requirements.

The Costs of Tendering survey specifically requested comments on the value of circulating draft specifications to tenderers, prior to calling for tenders. Around 50% of the respondents favoured this approach, while all participants in our survey favoured pre-release of specifications. It is possible that this difference is due to the large size and complexity of the projects we were investigating, when compared to the more general scope of the Costs of Tendering survey. Individual comments provided on the pre-release of specifications were almost identical to those in our survey, however, and included the following:

- Circulation of draft specifications provides more time for the tenderer.
- Commercial advantages and disadvantages of providing feedback.
- Allows early decision on whether to tender.
- Increases time and effort required to tender.
- Can be confusing if there are significant changes to the specification.

17. Conclusions

This survey has provided a valuable insight into industry's perceptions of Navy specifications for complex computer based systems. It has identified many of the perceived weaknesses of specification practices, as well as some of the strengths, and has provided a sound basis for the investigation and improvement of those practices in the future.

Appendix 1 - Survey Questionnaire

The following questionnaire was sent to participants prior to interviews and were used as the basis for discussions.

Background

We are currently tasked by Navy to review Navy's specification and evaluation practices for complex operational computer based systems (such as combat systems). We expect that the results will have a wider impact, both in Navy and Defence.

As part of this task we are conducting a survey within both Navy and defence industry to investigate the perceived problems in Navy specifications.

It is likely that the findings of this task will be releasable to the defence community, at least in part.

The survey

Attached is a list of questions which we are using as the basis for discussions with defence industry in Australia. Although phrased as a series of questions, it is not intended that participants will complete the questionnaire themselves, although you may chose to do so. We would prefer to discuss these and other issues with you, using the questionnaire to guide the discussions.

Individual answers to these questions will not be formally recorded or published and will be treated confidentially. This is essential to increase the frankness and honesty of answers.

Participants are encouraged to address specific projects and specifications rather than provide a general response from their experience.

Questionnaire

Where possible, please address your answers to specific projects and specifications. The specifications of interest are generally those provided as part of an RFP or RFT process.

1. What Navy projects/specifications have you recently experienced?

2. What was your general impression of the specification in comparison with those for other projects?

3. What specific strengths did you perceive in the structure, content and language of the specification?

4. What specific problems were in your opinion caused by the structure, content and language of the specification?

5. Do you have any comments about the level of specification, particularly with regard to pure performance based specifications (which do not define functional requirements)?

6. Do you have any comments on the completeness of specification? Would you have appreciated more information?

7. Do you have any suggestions with regard to the specification of non-functional requirements (including quality factors)?

8. What advantages do you see in viewing a pre-release specification and being able to provide comments?

9. What factors cause difficulties in understanding and using Navy specifications?

10. What changes to specifications or to the specification process would improve your ability to understand Navy specifications and to respond to them?

11. How do these specifications differ from those that you supply to your own subcontractors?

12. Do you use any specific tools to analyse or break down specifications for further use (eg requirements tracking)?

13. What are your preferences with regard to the electronic form of specifications?

14. Any other comments?

Appendix 2 - Traceability Matrix

The following table provides traceability of issues identified in this report to the sections where these issues are addressed in subsequent reports.

Section	Issue	See Report:Section
4.1	Assumptions by drafters	3:6.2.1
4.2	"Cut and paste" from previous projects	2:4.2.3, 3:6.2.2
4.3	"Glossy brochure" approach	3:6.2.3
4.4	Precluding modern technology	3:6.2.4
4.5	"Umbrella" clauses	3:6.4
4.6	Environmental constraints	3:5.2.d
4.7	Traceability of requirements	2:4.2.4, 3:4., 5.5.e
4.8	Use of standards	3:6.2.5
5.1	Uneven level of requirements	2:4.3.4, 3:5.2.c, 5.5, 6.3
5.2	Vague requirements	3:5.2.b, 6.1.b, 6.3, 6.8.1
5.3	Underspecification, overspecification	2:4.3.4, 3:3.6, 6.3
6.1	Use of defined formats	2:3.3, 3:3.2
6.2	Individual format issues	3:6.4, 6.7
6.3	Numbering of requirements	3:5.5.e, 6.7
6.4	Precedence	2:4.3.6, 3:6.6
6.5	Dispersed requirements	3:6.7
7.	Verification of requirements	3:5.4.b
8.	Prioritisation of requirements	3:4.1, 6.5, 7.
9.1	Language: definition and use of terms	2:4.3.5, 3:6.8
9.2	Language: concurrency	3:6.9.1
9.3	Language: alternative functions	3:6.8.2
10.	Non-functional requirements	2:4.3.3, 3:6.10
11.	Security issues	3:6.11.3
12.	Electronic form of specifications	2:4.2.5, 3:6.11
13.	Pre-release of specifications	2:4.2.6, 3:7.2
14.1	Need for operational information	3:7.1
14.2	Need for quality guidelines	2:4.2.1, 3:9.
14.3	Relationship between developer and customer	3:7.

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19. Abstract

This paper presents the results of a survey of companies involved in the development and supply of complex operational computer based systems for Navy. The objective of the survey was to gain feedback from industry regarding the quality of Navy's requirements specifications. The survey is part of a more general study aimed at improving Navy's specification and evaluation practices.